QD-21U Voltage Transducer

I. Product Definition

The Qidian QD-21U is a three-terminal isolated AC/DC voltage transmitter designed specifically for voltage signal acquisition and conversion in industrial environments. It serves as a core module in automation control systems for achieving voltage signal isolation, transmission, and standardized output.

Its core functions can be broken down into the following five aspects:

1. Wide-Range AC/DC Voltage Signal Acquisition

Supports universal AC/DC voltage input (e.g., AC 0–1000 V as indicated in the image; also compatible with DC ranges of the same magnitude). It can directly acquire various AC/DC voltage signals from industrial sites, such as grid voltage, motor busbar voltage, and equipment supply voltage, without the need for additional voltage divider circuits.

2. High-Precision Signal Isolation (Three-Terminal Isolation Architecture)

Achieves complete electrical isolation across the input, output, and power supply terminals. The isolation strength effectively blocks ground loop interference, common-mode interference, and surge impacts in industrial environments, protecting downstream devices such as PLCs, DCS systems, and data acquisition modules from damage caused by high-voltage surges and electromagnetic interference.

3. Standardized Industrial Signal Conversion

Converts acquired non-standard voltage signals into standard signals commonly used in industrial automation systems, such as the 4–20 mA current signal shown in the image. It also supports voltage signal outputs such as 0–5 V and 0–10 V, making it compatible with the input interfaces of the vast majority of PLCs, industrial PCs, and digital display instruments.

4. High-Stability Signal Conditioning and Interference Suppression

Built-in signal filtering and linear compensation circuits filter out high-frequency noise and spike interference in industrial environments, ensuring the linearity and stability of the output signal. This provides reliable data acquisition even in environments with strong electromagnetic interference.

5. Industrial-Grade Wide Temperature Range and Power Supply Compatibility

Supports 24V DC industrial standard power supply (as indicated in the image), compatible with common power supply systems in automation environments. The wide operating temperature range covers the vast majority of industrial field environments. Supports DIN rail mounting, compatible with standard DIN rails, for easy installation.

II. Working Principle and Process

1. Core Principle

The core logic of the QD-21U voltage transmitter is to achieve safe and precise conversion of voltage signals in industrial environments through a closed-loop process of “signal acquisition – electrical isolation – signal conditioning – standardized output.” Its core technology relies on electromagnetic isolation / opto-isolation technology combined with high-precision linear conditioning circuits, balancing electrical isolation safety with signal conversion accuracy.

Complete Operating Process

1. Signal Acquisition Stage

AC and DC voltage signals from industrial sites (e.g., AC 0–1000 V) are fed into the internal acquisition circuit via the transmitter’s input terminals (IN+, IN-). The circuit first performs voltage division and current limiting on the high-voltage signal, converting it into a low-voltage signal suitable for the isolation circuit, while simultaneously providing preliminary protection against surges and overvoltage.

2. Three-Terminal Electrical Isolation Stage

The acquired low-voltage signal enters the isolation unit. Using electromagnetic or opto-electrical isolation technology, the high-voltage and interference signals on the input side are completely physically isolated from the output and power supply sides. This blocks the conduction paths of ground loop currents and common-mode interference, ensuring that the “input, output, and power supply” terminals are mutually isolated from ground, thereby completely eliminating the risk of interference and high-voltage surge transmission.

3. Signal Conditioning and Linear Compensation Stage

The isolated, clean signal enters a high-precision conditioning circuit, which filters, amplifies/attenuates, and linearly compensates the signal to correct signal errors and ensure a linear relationship between the input voltage and the output signal (e.g., an input of 0–1000 V AC corresponds to an output of 4–20 mA), while simultaneously suppressing high-frequency noise and spike interference.

4. Standardized Output Stage

The conditioned signal is converted into an industrial standard signal (such as a 4–20 mA current signal) and transmitted via the output terminals (OUT+, OUT−) to downstream devices such as PLCs, DCS systems, and digital display instruments, enabling remote acquisition and monitoring of voltage signals.

5. Power Supply Stage

The transmitter is powered by a 24 V DC industrial power supply. The power supply side is also isolated to prevent power fluctuations and interference from affecting the stability of the input and output signals, while providing a stable operating voltage for the internal circuitry.

III. Core Value and Addressing Customer Pain Points

1. Core Value

The core value of the QD-21U is to provide a safe, precise, stable, and versatile voltage signal acquisition solution for industrial automation systems. It addresses the four key challenges of voltage signal acquisition in industrial environments—high-voltage risks, severe interference, signal incompatibility, and equipment susceptibility to damage—thereby achieving a closed-loop system of “safe front-end acquisition and stable back-end adaptation.”

2. Addressed Customer Pain Points and Corresponding Benefits

1. Customer Pain Points: High-voltage signals in industrial environments (e.g., 1000 V AC) cannot be directly connected to PLCs or instruments, which can easily cause equipment burnout.

Transmitter Solution: Built-in voltage divider + three-terminal isolation circuit, enabling direct acquisition and isolation of high-voltage signals

Direct Benefits: Eliminates the need for custom voltage divider or isolation modules, reduces the risk of equipment damage, and saves on component costs

2. Customer Pain Point: Ground loop interference and common-mode interference in the field cause data fluctuations and significant errors, affecting system control accuracy Transmitter Solution: A three-terminal electrical isolation architecture blocks interference transmission paths, and works with filtering circuits to suppress noise

Direct benefits: Stable output signals without fluctuations; acquisition accuracy up to ±0.3% (as shown in the image), ensuring system control precision

3. Customer pain points: Diverse types of AC/DC voltage signals in the field that are incompatible with PLC/instrument input interfaces

Transmitter Solution: Supports universal AC/DC acquisition and can convert signals to standard industrial formats such as 4-20mA or 0-10V.

Direct Benefits: No need to replace PLCs or instruments; compatible with the interfaces of the vast majority of automation equipment, enhancing system compatibility.

4. Customer Pain Point: Surge impacts and electrostatic interference caused by multiple devices sharing a common ground, which can easily damage downstream precision equipment.

Transmitter Solution: Fully electrically isolated inputs and outputs, with isolation strength capable of withstanding industrial field surge impacts

Direct Benefits: Protects downstream precision equipment such as PLCs and industrial PCs, extends equipment lifespan, and reduces downtime due to failures

5. Customer Pain Points: Traditional data acquisition solutions involve complex wiring and difficult maintenance, resulting in low efficiency during on-site installation and commissioning

Transmitter Solution: DIN-rail mounting, terminal block wiring, no complex calibration required, and stable operation immediately upon power-up

Direct Benefits: Easy installation, simple commissioning and maintenance, and reduced on-site construction and maintenance costs

6. Customer Pain Points: Harsh industrial environments (strong electromagnetic interference, significant temperature and humidity fluctuations) result in poor stability of data acquisition modules

Transmitter Solution: Industrial-grade design, wide operating temperature range, and strong resistance to electromagnetic interference

Direct Benefits: Suitable for the vast majority of industrial environments, ensuring stable and reliable long-term operation and reducing downtime due to failures

4: Specifications

4.1 Basic Electrical Specifications
Product Model: QD-21U
Input Signal Type: AC/DC Universal Voltage
Standard Input Range: AC 0–1000 V Customizable upon request: AC 0–50 V/100 V/250 V/500 V/1000 V; DC 0-70mV to 0-1000V, etc.
Output Signal Type: Standard Industrial Current / Voltage Signal 4-20mA, Customizable: 0-5V, 0-10V, 1-5V, 0-20mA, etc.
Output Load Capacity: Current Type: ≤500Ω; Voltage Type: ≥2kΩ
Accuracy Grade: ±0.3% FS (as indicated in the image) Full-scale error ≤0.3%,
Linearity Error: ≤±0.1% FS
Repeatability Error: ≤±0.1% FS
Response Time: ≤100 ms
Ripple and Noise: ≤10 mVpp
Frequency Response: 0–50 Hz

Isolation Performance Parameters
Isolation Architecture: Three-terminal full isolation (complete electrical isolation between input, output, and power supply)
Isolation Withstand Voltage: ≥2500 V AC (between input–output, input–power supply, and output–power supply)
Common-Mode Rejection Ratio: ≥100dB (50Hz)
Insulation Resistance: ≥100MΩ (tested at 500V DC)
Isolation Method: Electromagnetic Isolation / Optical Isolation

Power Supply & Power Consumption Parameters
Standard Supply Voltage: DC 24V (Power supply: DC 24V)
Supply Voltage Range: DC 18V–30V
Reverse Polarity Protection: Built-in reverse polarity protection circuit
Full-Load Power Consumption: ≤1.5W
Power Distribution Output: No built-in power distribution

Environmental Parameters
Operating Temperature: -20°C to +60°C
Extended Operating Temperature: -40°C to +85°C (Custom Version)
Storage Temperature: -40°C to +85°C
Operating Humidity: 10% to 90% RH (non-condensing)
Protection Rating: IP30 (Enclosure Protection)
Explosion-Proof Rating: Non-explosion-proof (Standard Version); Intrinsically Safe available upon request (Compatible with safety barrier models: e.g., Zener-type / Isolation-type safety barriers)
Electromagnetic Compatibility: Compliant with GB/T 17626 Industrial EMC Standard

Physical Parameters
Mounting Method: Standard 35mm DIN rail mounting
Dimensions: Approx. 110mm (L) × 22.5mm (W) × 80mm (H)
Weight: Approx. 120g Lightweight design
Indicator Light Definitions: 1. PWR Power Indicator (labeled in image): Steady on = Normal power supply; Off = Power supply abnormality / Power failure
2. Customizable ALM Alarm Indicator: Flashing = Signal out of range / Fault; Steady on = Normal operation Intuitive assessment of device operating status, no additional testing required
Housing Material: Blue flame-retardant ABS engineering plastic Insulating, flame-retardant, anti-aging, and chemical-resistant
Terminal Blocks: Plug-in screw terminal blocks (12-pin, divided into three groups: Power, Input, Output)
Protection Details: One-piece molded housing, terminals with anti-disengagement latches, internal potting for moisture protection (optional)

5. Application-Based Selection Guide

This module addresses the core pain points users face—namely, "not knowing how to select the right model" or "choosing the wrong model." By leveraging the product features of the Qidian QD-21U three-terminal isolated AC/DC voltage transmitter with a blue housing, it follows a logical framework of "Selection Criteria → Application Recommendations → Common Pitfalls → Customized Solutions" to provide actionable selection recommendations. These recommendations balance general applicability with industry-specific needs, catering to the the selection requirements of industrial sites across various sectors.

5.1 Key Selection Dimensions (Must-Read! The First Step to Accurate Selection)
Selection must be based on "on-site operating conditions." Focus on these five essential dimensions—none can be overlooked. By combining these with the QD-21U's product features, we clarify key selection points one by one to avoid blind selection:
1. Signal Type (Core Prerequisite)
Key Consideration: Determine the type of voltage to be acquired on-site (AC or DC) and the specific measurement range. This forms the foundation of the selection process; choosing the wrong voltage type will directly prevent the device from functioning properly, while selecting the wrong range will affect measurement accuracy.
Recommendations: The Qidian QD-21U supports universal AC/DC voltage acquisition. The standard range is AC 0–1000 V (see image annotations), with customizable ranges including DC 0–70 mV to 0–1000 V, and AC 0–50 V, 100 V, 250 V, or 500 V. If on-site voltage fluctuations are significant, it is recommended to select a range based on "1.2 to 1.5 times the maximum measured voltage" to allow for a margin of safety and prevent signal distortion caused by over-range conditions.
2. Number of Channels (Adapting to System Requirements)
Key Consideration: Select the appropriate channel configuration based on the number of voltage channels required for on-site data acquisition and output signal needs to avoid cost wastage from redundant channels or failure to meet acquisition requirements due to insufficient channels.
Recommendations: The standard QD-21U model features 1 input and 1 output (1 voltage input, 1 standard signal output). Customizable configurations include 1 input and 2 outputs (1 input, 2 independent outputs to accommodate different backend devices) and 2 inputs and 2 outputs. For typical industrial scenarios (single-path voltage acquisition), the 1-input-1-output model is sufficient; for scenarios involving multiple devices or multi-path voltage acquisition, opt for a multi-channel model.
3. Power Supply Method (Adapting to On-Site Power Systems)
Key Consideration: Select a power supply type that matches the existing power supply method at the industrial site to avoid device startup failures due to power incompatibility. Also, ensure the device can adapt to power fluctuations.
Recommendations: The standard QD-21U model from Qidian operates on 24 V DC (see image annotation), compatible with common industrial automation power systems. It supports a supply voltage range of 18 V to 30 V DC and features a wide-voltage fault-tolerant design to accommodate on-site voltage fluctuations; If the site uses AC 220V power, a custom AC 85–265V wide-voltage model is available, eliminating the need for additional power conversion modules and reducing installation costs.
4. Explosion-Proof Requirements (Adaptation for Hazardous Environments)
Key Consideration: Determine whether the site is a flammable or explosive environment (e.g., chemical plants, oil and gas stations). Strictly distinguish between explosion-proof and non-explosion-proof scenarios to prevent safety incidents caused by improper selection.
Recommendations: The standard QD-21U model is non-explosion-proof and suitable for general industrial settings (e.g., standard workshops, electrical rooms). For explosion-hazardous environments (e.g., chemical or oil and gas sectors), an intrinsically safe explosion-proof version can be customized to support Zener-type or isolating safety barriers, ensuring safe operation in hazardous zones and eliminating potential safety risks.
5. Installation Environment (Ensuring Long-Term Stable Operation)
Key Considerations: Select the appropriate product configuration based on on-site temperature, humidity, electromagnetic interference levels, installation space, and protection requirements to prevent equipment failures or performance degradation caused by environmental factors.
Recommendations: The Qidian QD-21U standard model features 35mm DIN rail mounting, an IP30 enclosure rating, and an operating temperature range of -20°C to +60°C, making it suitable for installation in standard industrial control cabinets. For sites with extreme high or low temperatures (such as outdoor solar power plants or cold storage facilities), a wide-temperature version (-40°C to +85°C) can be customized; In environments with strong electromagnetic interference (such as substations or steel mills), no additional configuration is required. The product features built-in anti-interference circuitry that complies with the GB/T 17626 industrial EMC standard, effectively blocking electromagnetic radiation interference. For humid or dusty environments,

a potted moisture-proof version can be customized to enhance protection.

5.2 Industry Applications

1. Chemical Industry:

Some areas are explosion-proof environments with corrosive media and strong electromagnetic interference. It is necessary to monitor the power supply voltage of the equipment and the voltage of the reactor. Some environments are humid and dusty. Standard model (non-explosion-proof areas); Custom Intrinsically Safe Explosion-Proof Model + Encapsulated Moisture Protection (Explosion-Proof Areas), Input Range: AC 0–380 V/500 V, Output: 4–20 mA, DC 24 V Power Supply.

2. Power Industry (Substations, Switching Stations):

High-voltage data acquisition (AC 0–1000 V), extremely strong electromagnetic interference, multi-path voltage acquisition, requiring stable signal transmission to PLC/DCS systems, 24-hour continuous operation. Standard model (1 input, 1 output); Custom multi-channel model (2 inputs, 2 outputs / 4 inputs, 4 outputs), input range AC 0–1000 V, output 4–20 mA, 24 V DC wide-range power supply.

3. Metallurgical Industry (Steel Mills, Smelting Workshops):

High-temperature environments (some areas >60°C), strong electromagnetic interference, significant vibration, requiring measurement of motor busbar voltage and heating equipment voltage, with high dust levels. Customized wide-temperature model (-40°C to +85°C), input range AC 0–500V/1000V, output 4–20mA, DC 24V power supply, with ruggedized housing protection.

4. Pharmaceutical Industry (Pharmaceutical Workshops, Cleanrooms):

Clean environment with stable temperature and humidity (normal conditions). Requires monitoring of power supply voltages for pharmaceutical equipment and sterilization equipment; high measurement accuracy is required; no explosion-proof requirements. Standard model (1 input, 1 output), input range AC 0–220 V/380 V, output 4–20 mA, accuracy ±0.3% FS, 24 V DC power supply.

5. Smart Manufacturing (Automated Production Lines, Robotics Applications):

Equipment layouts are compact, with most applications involving DC voltage measurement. Seamless integration with PLCs and industrial PCs is required. Some scenarios demand multi-channel synchronous data acquisition, and installation space is limited. Standard model (customizable DC range); customized compact 1-input, 2-output model with 4–20 mA/0–10 V output, powered by 24 V DC, suitable for tight installation spaces.

6. New Energy Industry (PV, Energy Storage):

Outdoor or semi-outdoor environments with significant temperature and humidity fluctuations. Requires acquisition of DC voltage from photovoltaic modules and energy storage batteries, with high demands for electromagnetic interference (EMI) resistance and UV protection. Customized wide-temperature models (-40°C to +85°C) with UV-resistant enclosures, customizable DC range (0–500 V/1000 V), 4–20 mA output, and 24 V DC power supply.

5.3 Common Selection Pitfalls (A Guide to Avoiding Mistakes—A Must-Read!)

Based on common issues encountered during product selection in industrial settings and tailored to the features of the Qidian QD-21U, this section outlines four major pitfalls, explains their risks, and provides correct selection methods to prevent equipment damage, system failures, or wasted costs resulting from incorrect selection:

1. Pitfall 1: Ignoring Isolation Levels and Selecting Products Arbitrarily

Common Mistake: Believing that "as long as voltage can be acquired, it's sufficient," and overlooking three-terminal isolation performance; selecting two-terminal isolated or non-isolated transmitters in high-voltage, high-interference environments (such as power generation and metallurgy).

Consequences: Inability to block ground loop interference and common-mode interference, leading to data fluctuations, excessive errors, or even the transmission of high-voltage signals to downstream PLCs or industrial PCs, resulting in the destruction of precision equipment and triggering safety incidents.

Correct Approach: The core advantage of the Qidian QD-21U is its three-terminal full isolation (input/output/power supply), with an isolation withstand voltage of ≥2500V AC and a common-mode rejection ratio (CMRR) of ≥100dB. This model must be selected for high-voltage and high-interference environments. In standard environments where cost control is a priority, simplified models may be considered only after confirming the absence of high voltage and strong interference; however, the three-terminal isolated model is strongly recommended to ensure equipment safety and signal stability.

2. Misconception 2: Selecting the wrong signal range, affecting measurement accuracy

Common errors: Blindly selecting the maximum range (e.g., selecting the AC 0–1000V range when the actual on-site voltage is 220V AC), or selecting a range that is too small (e.g., selecting the 0–250V range when the actual voltage is 380V).

Consequences: An excessively wide range causes a significant drop in measurement accuracy (e.g., using a 1000V range to measure 220V mains power results in accuracy plummeting from ±0.3% FS to over ±1%), failing to meet system control requirements; a range that is too narrow can cause the signal to exceed the measurement range, preventing the transmitter from outputting normally and potentially damaging internal circuits.

Correct Approach: Select the range based on the actual maximum voltage to be measured on-site, taking into account the fluctuation range. Typically, choose a range of "actual maximum value × 1.2–1.5 times." The Qidian QD-21U supports custom range settings. If the actual range is uncertain, provide the on-site operating conditions, and the manufacturer can assist in matching the optimal range to avoid wasted accuracy or over-range issues.

3. Misconception 3: Neglecting Load Matching, Resulting in Failed Signal Transmission

Common Mistake: Focusing only on input and output signal types while ignoring the matching of the transmitter's output load with the input impedance of the downstream PLC or instrument. For example, selecting a 4–20 mA output model but pairing it with a PLC having a load resistance >500 Ω.

Consequences: The output signal is suppressed by the load and cannot be transmitted normally to the downstream equipment, resulting in the system's inability to collect voltage data, failure of equipment monitoring, and even potential burnout of the transmitter's output module.

Correct Approach: For the Qidian QD-21U, the load impedance for current-output models is ≤500Ω, and for voltage-output models, it is ≥2kΩ. Before selection, verify the input impedance of the downstream PLC or instrument. If the load is mismatched, a custom load-matched model can be ordered, or a signal amplifier can be added to ensure stable signal transmission. Additionally, note that current signals are suitable for long-distance transmission, while voltage signals are suitable for short-distance parallel transmission; select the output type based on the transmission distance.

4. Misconception 4: Selecting a General-Purpose Model for Explosion-Proof Environments—Non-Compliant and Dangerous

Common Error: In explosion-proof zones such as chemical and oil & gas facilities, users opt for the standard non-explosion-proof QD-21U model to save time and costs, without customizing an explosion-proof version or pairing it with a safety barrier.

Hazards: This violates industrial safety regulations and may trigger explosions of flammable and explosive gases, resulting in equipment damage and personal injury or death. It also risks penalties for failing safety inspections.

Correct Procedure: In explosion-proof environments, the Qidian QD-21U must be selected in a customized intrinsically safe explosion-proof version, paired with the corresponding safety barrier (Zener-type or isolation-type) to ensure safe operation in the area. In non-explosion-proof environments, the standard version may be selected to avoid unnecessary costs.

5.4 Customization Recommendations (Solutions for Special Scenarios)

To address personalized requirements such as special signals in industrial environments, non-standard operating conditions, and multi-channel integration, the Qidian QD-21U supports comprehensive customization. By combining product features with industry expertise, we offer the following customized solutions that overcome the limitations of off-the-shelf models, adapt to various non-standard scenarios, and avoid cost wastage caused by redundant features:

1. Special Signal Customization (Adaptation to Non-Standard Input/Output Requirements)

Applicable Scenarios: On-site voltage signals are within non-standard ranges (e.g., DC 0–70 mV, AC 0–150 V); output signals must be adapted for specific equipment (e.g., 1–5 V, 0–20 mA); or simultaneous output of both current and voltage signals is required.

Customization Options: ① Input Range Customization: Any non-standard AC/DC range can be customized based on actual field voltages, with a minimum support of DC 0–70 mV and a maximum expandable to AC/DC 0–1000 V or higher; ② Customized output signals: Supports any standard signals such as 4–20 mA, 0–5 V, 0–10 V, 1–5 V, and 0–20 mA. Can be configured with 1 input and 2 different output types (e.g., one 4–20 mA and one 0–10 V) to accommodate various downstream devices; ③ Customizable signal types: For high-frequency voltage signals (>50 Hz), a wide-frequency-response version can be customized to meet the voltage acquisition requirements of high-frequency equipment.

2. Customization for non-standard operating conditions (adapted to extreme/special environments)

Applicable Scenarios: Extreme temperature and humidity (e.g., -40°C low temperature, +85°C high temperature), highly corrosive environments (e.g., chemical environments with corrosive media), high-vibration environments (e.g., metallurgical smelting workshops), and outdoor environments with high humidity and dust.

Customization Solutions: ① Temperature and Humidity Customization: Wide-temperature models (-40°C to +85°C) utilize components resistant to high and low temperatures to ensure stable performance under extreme conditions; ② Protection Customization: Potent-sealed moisture-proof model (protection rating upgraded to IP65) and corrosion-resistant housing (customized anti-corrosion ABS material), suitable for humid, dusty, and highly corrosive environments; ③ Vibration-Resistant Customization: Reinforced internal components and added cushioning structures to withstand high-vibration environments and prevent component loosening that could cause malfunctions; ④ Outdoor Customization: Features an anti-UV coating to prevent housing degradation, suitable for outdoor applications such as solar power and energy storage.

3. Multi-Channel Integration Customization (Suitable for Multi-Path Data Acquisition Needs)

Applicable Scenarios: On-site scenarios requiring simultaneous acquisition of multiple voltage signals (e.g., multi-circuit voltages in power distribution rooms or voltages from multiple devices on smart manufacturing production lines), where centralized management and synchronized signal output are required, and installation space is limited.

Customization Solutions: ① Channel Configuration: Supports multi-channel configurations such as 2-in/2-out, 4-in/4-out, and 8-in/8-out. All channels maintain three-terminal isolation to prevent mutual interference, ensuring precise signal acquisition for each channel; ② Integrated Design: Multiple channels are integrated into a single blue housing, still utilizing 35mm DIN rail mounting, saving control cabinet space and facilitating centralized debugging and maintenance; ③ Synchronized Output Customization: Supports customized synchronized output of multiple signals, ensuring that downstream PLC/DCS systems collect and process data in sync, thereby improving system control efficiency.

4. Other Customization Options

① Power Supply Customization: Standard configuration is 24V DC; can be customized for 85–265V AC wide-voltage power supply to accommodate on-site AC power scenarios, eliminating the need for additional power converters; ② Indicator Light Customization: The standard model comes with a PWR power indicator light as standard; an ALM alarm light can be customized to provide intuitive alerts for out-of-range signals and equipment failures, facilitating rapid troubleshooting; ③ Housing Customization: In addition to the standard blue flame-retardant ABS housing, housings in different colors and materials can be customized to match on-site equipment color schemes; ④ Customizable Communication Features: RS485 digital communication can be added to support remote data acquisition, calibration, and diagnostics, meeting the requirements of intelligent monitoring systems.

Customization Notes: Before customization, please clearly specify the on-site operating conditions (signal type, measurement range, ambient temperature and humidity, explosion-proof requirements, and number of channels). The manufacturer will optimize the customization plan based on these requirements to ensure the customized unit is fully compatible with the on-site conditions. Technical support will also be provided to assist with installation and commissioning, ensuring stable equipment operation.

6. Installation and Commissioning Guidelines (Practical Recommendations)

The core purpose of this module is to provide on-site technicians with step-by-step practical guidance, covering pre-installation preparations, standard procedures, wiring diagrams, power-on commissioning, and installation precautions. The entire process is tailored to the structural characteristics of the Qidian QD-21U blue-cased three-terminal isolated AC/DC voltage transmitter (refer to the terminal definitions and installation methods indicated in the images), thereby minimizing installation errors and ensuring stable operation and accurate data acquisition after installation.

6.1 Pre-Installation Preparation (Laying a Solid Foundation to Avoid Re-work Later)

Before installation, a comprehensive inspection and preparation must be completed to ensure all accessories are present, the environment is suitable, and tools are available. This also helps mitigate safety risks and lays the groundwork for subsequent installation and commissioning. All preparatory tasks must be carried out one by one without omission.

1. Component Verification (Compare with image annotations to confirm no missing or damaged parts)

After unpacking, compare the contents against the parts list and the product image annotations to verify each of the following components one by one, ensuring they are complete and undamaged. If any parts are missing or damaged, contact the manufacturer immediately for replacement to avoid affecting the installation schedule:

- Core Equipment: 1 unit of Qidian QD-21U Blue-Housed Three-Terminal Isolated AC/DC Voltage Transmitter (confirm the housing is undamaged, the blue flame-retardant ABS material is intact, terminals are not deformed, labels are clear, and match the image annotations);
- Wiring Accessories: 1 set of pluggable screw terminals (12-pin, divided into power, input, and output groups, matching the terminal layout in the image), 2–4 mounting screws (for 35mm DIN rail mounting);
- Auxiliary Accessories: 1 user manual, 1 certificate of conformity (verify that the manual matches the product model and that the parameters on the certificate match those in the image);
- Optional Accessories: Shielded signal cable (RVVP 2×1.0mm² recommended), grounding terminal, electrical tape, terminal insulation caps (prepare according to on-site wiring requirements).

2. Environmental Inspection (Adapt to equipment operating conditions to ensure long-term stable operation)

Refer to the QD-21U product specifications to inspect the installation site environment and ensure it meets the equipment's operational requirements. Focus on verifying the following four points to prevent equipment failures caused by environmental factors:

- Temperature and Humidity: The installation environment temperature must be between -20°C and +60°C (standard model), with humidity between 10% and 90% RH (non-condensing). Avoid installation near high-temperature heat sources (such as variable frequency drives or heating equipment) or in damp, water-logged areas. For extreme temperature and humidity conditions, replace with a custom wide-temperature or potted moisture-proof model in advance;
- Electromagnetic Environment: Keep the device at least 50 cm away from strong sources of electromagnetic interference (such as transformers, high-power motors, and variable frequency drives) to prevent signal fluctuations caused by electromagnetic interference. If sufficient distance cannot be maintained, use shielded signal cables and ensure proper grounding;
- Installation Space: Ensure there is sufficient installation space within the control cabinet. Reserve a length of at least 120 mm on the 35 mm DIN rail (to accommodate the device's 110 mm length). Leave a clearance of at least 10 mm around the device to facilitate heat dissipation and future maintenance;
- Environmental Protection: In standard environments, ensure the installation location is free of conductive dust and corrosive gases. In explosion-proof environments, verify that the site's explosion-proof rating matches the customized equipment, and check that the safety barrier installation meets the requirements of the GB50058 standard.

3. Tool List (Prepare in advance to improve installation efficiency)

Prepare the following common tools, ensuring they are in good condition and meet accuracy standards to avoid installation errors caused by missing or damaged tools. The tool list may be supplemented based on actual on-site conditions:

- Basic Tools: Phillips screwdriver, flathead screwdriver (for terminal screws), wire strippers (stripping range 0.5–2.5 mm²), crimping pliers, torque wrench (0.5–5 N·m);
- Testing Tools: Multimeter (capable of measuring voltage and current, accuracy ≥ Class 0.5), insulation tester (500 V DC, for measuring

insulation resistance), signal generator (optional, for subsequent signal verification);
- Auxiliary Tools: Electrical tape, cable ties, marker pen, flashlight (for working inside control cabinets), terminal insulation caps (to cover unused terminals).
4. Safety Precautions (Top Priority: Mitigating Safety Risks)
Strictly adhere to the following safety regulations during installation to prevent accidents such as electric shock or equipment damage. Installation personnel must ensure proper personal protection:
- Personal Protection: Wear insulated gloves and insulated shoes before starting work. Do not touch exposed terminals or live equipment with bare hands. Wear a safety harness when working at heights;
- Power Disconnection: Before installation or wiring, the relevant on-site power sources (including the transmitter's power supply and input signal power sources) must be disconnected. Hang a "Do Not Operate, Work in Progress" sign. Confirm that power is off before proceeding to avoid short circuits or electric shock caused by live wiring;
- Insulation Testing: Before wiring, use an insulation tester to measure the insulation resistance between the transmitter terminals to ensure it is ≥100 MΩ (tested at 500 V DC). If the insulation does not meet the standard, installation and use are strictly prohibited;
- Other Prohibitions: Do not drill holes or strike the equipment housing to avoid damaging internal circuits; do not disassemble the equipment without authorization, as this will void the product warranty and may cause equipment failure.

6.2 Standard Installation Procedure (Step-by-Step Guide for Proper Installation)
Install the device step by step in the following order: "Rail Mounting → Wiring → Grounding." Follow the installation specifications of the Qidian QD-21U (35mm DIN rail mounting, 12-pin terminal layout) throughout the process. Each step must be performed correctly to ensure the device is securely mounted and wired properly.
1. Rail Mounting (Secure Installation, Prevent Vibration and Loosening)
The Qidian QD-21U uses standard 35mm DIN rail mounting, compatible with universal rails in industrial control cabinets. The installation steps are as follows:
1. Verify that the 35mm DIN rail inside the control cabinet is securely installed, with no looseness or deformation. Ensure the rail surface is free of oil, grease, or debris; if any debris is present, clean it thoroughly;
2. Hold the transmitter (with the blue housing facing the direction that allows easy observation of the indicator lights and wiring), align the rail latches on the bottom of the device with the rail, and press firmly until you hear a "click," indicating initial fixation;
3. Gently shake the transmitter by hand to ensure it is securely fixed with no looseness or wobbling. If loose, adjust the latch position and press firmly to secure it again. If necessary, use screws for additional fastening, controlling the torque between 3–4 N·m to avoid deformation of the housing caused by over-tightening;
4. Verify that the device's installation location meets environmental requirements: keep it away from sources of interference and heat, ensure sufficient clearance for heat dissipation and maintenance, and maintain a minimum clearance of 10 mm from other equipment.
2. Wiring Guidelines (Distinguish Terminals Accurately to Prevent Misconnection)
Refer to the terminal definitions labeled in the diagram (Input side: IN+, IN-; Output side: OUT+, OUT-, 0V; Power supply side: 24V+, 24V-). Strictly distinguish between power supply, input, and output terminals, and wire according to specifications. The wiring sequence is "connect input first → then output → finally power supply." Specific steps are as follows:
- Input Terminal Wiring (IN+, IN-, corresponding to terminals 1-2 in the image):
  - For AC voltage measurement (e.g., AC 0-1000V): Connect the positive and negative leads of the on-site AC voltage signal line to the IN+ and IN- terminals, respectively. There is no need to distinguish between positive and negative (AC has no polarity), but ensure the connections are secure to prevent loose connections;
  - For DC voltage measurement (e.g., DC 0–500 V): Strictly distinguish between positive and negative polarities. Connect the positive terminal of the DC voltage to the IN+ terminal and the negative terminal to the IN- terminal. Reversing the connections will result in abnormal signal acquisition and may even damage the device;
  - Wiring Requirements: Strip the signal wires to a length of 5–8 mm. After stripping, ensure the exposed copper wire is not too long (no more than 2 mm). After connecting to the terminals, tighten the screws with a torque of 0.8–1.2 N·m to prevent loose connections or wire breakage. Unused input terminals must be sealed with insulating caps.
- Output terminal wiring (OUT+, OUT-, 0V; corresponding to terminals 7–9 in the figure):
  - 4–20 mA current output (labeled as "Standard Output" in the figure): Connect OUT+ to the positive terminal of the signal input on the downstream PLC/DCS, connect OUT- to the negative terminal of the signal input, and use 0V as the common ground. Whether to connect the 0V terminal depends on the requirements of the downstream equipment; if the downstream equipment does not require a common ground, the 0V terminal may be left floating;
  - 0-5V/0-10V voltage output (custom model): Connect OUT+ to the positive terminal of the downstream device's signal input, OUT- to the negative terminal, and 0V to the device ground. Ensure the output signal is impedance-matched with the downstream device's input (voltage-type output load ≥ 2kΩ);
  - Wiring requirements: It is recommended to use shielded twisted-pair cable for the output signal lines. Route these lines separately from the input signal lines and power lines to avoid interference. For shielding treatment, refer to the "Grounding Requirements" section.
- Power Terminal Wiring (24V+, 24V-, corresponding to terminals 10-12 in the diagram):
  - The standard power supply is DC 24V. Connect the positive terminal of the DC 24V power supply to the 24V+ terminal and the negative terminal to the 24V- terminal. Reversing the polarity is strictly prohibited (the device has built-in reverse polarity protection, but prolonged reverse connection may still damage internal circuits);
  - The operating voltage range is DC 18V to 30V. If the on-site power supply fluctuates significantly, a voltage regulator must be installed to prevent the device from malfunctioning due to excessively high or low voltage;
  - Wiring requirements: Use 1.5mm² copper wire for the power supply. Ensure connections are secure to prevent unstable power supply caused by poor contact. A 0.5A self-resetting fuse may be installed in series with the power supply line to enhance power supply safety.
3. Grounding Requirements (Ensuring Safety and Suppressing Interference)
The Qidian QD-21U is a three-terminal isolated transmitter. Proper grounding effectively suppresses electromagnetic interference and ensures equipment safety. Grounding procedures must strictly follow the specifications below and be performed in accordance with the terminal layout shown in the diagram:
- Enclosure Grounding: A grounding terminal is provided on the device's blue enclosure (if not marked, connect the ground wire to the enclosure mounting screw). Use a yellow-green grounding wire (≥2.5 mm² copper wire) to ground the enclosure. The grounding resistance must be ≤4 Ω to prevent safety hazards caused by a live enclosure;
- Shield Grounding: If shielded twisted-pair cables are used for input or output signals, the shield must be grounded at a single point (preferably on the control cabinet side). Strip the shield and connect it to the grounding terminal. Grounding at both ends is strictly prohibited (to avoid creating a ground loop and introducing interference);
- System Grounding: The transmitter's grounding must be connected to the same grounding grid as the on-site PLC and DCS systems. Under no circumstances should the grounding wire be mixed with the neutral (N) wire to avoid the risk of leakage current. Additionally, ensure the grounding grid is reliable and free of looseness or corrosion;
- Grounding in Explosion-Proof Environments: For explosion-proof custom-designed equipment, the enclosure and junction box must be connected to the on-site explosion-proof grounding grid using a 4 mm² yellow-green grounding wire. The grounding resistance must be ≤4 Ω. Additionally, ensure that the safety barrier is properly grounded to comply with explosion-proof safety regulations.

6.3 Wiring Diagram (For easy reference to prevent wiring errors)
Based on the features of the Qidian QD-21U standard model (1 input, 1 output; 24 V DC power supply; 4–20 mA output) and custom models, this document provides standard wiring diagrams (text-based illustrations that can be directly compared with the terminal layout in the images). It includes annotations for terminal numbers, positive and negative polarities, shielding wire handling, and specific wiring specifications, along with a correct/incorrect comparison to help field personnel quickly

wire the device and troubleshoot errors.

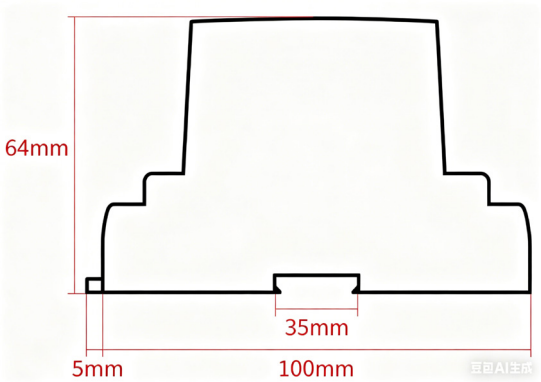
1. Standard Model Wiring Diagram (1 input, 1 output; AC/DC input; 4-20mA output; 24V DC power supply)

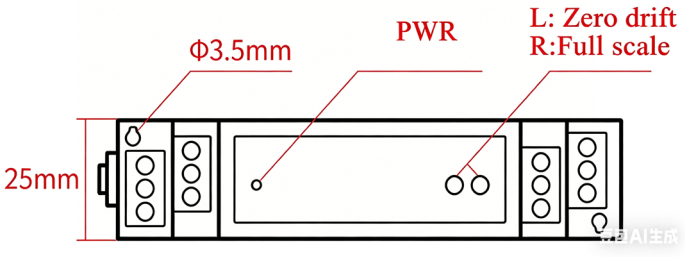
(Text-based diagram; can be used to directly reference the terminal layout in the image to draw a high-resolution wiring diagram; key annotations are as follows):

- Terminal 1 (IN+): Connect to the positive terminal of the on-site AC/DC voltage signal (DC must be connected to the positive terminal; AC has no positive or negative terminals);
- Terminal 2 (IN-): Connect to the negative terminal of the field AC/DC voltage signal (DC must be connected to the negative terminal; AC has no positive or negative terminals);
- Terminal 7 (OUT-): Connect to the negative terminal of the PLC/DCS signal input;
- Terminal 8 (0V): Common ground; can be connected to the PLC/DCS system ground (leave floating if grounding is not required);
- Terminal 9 (OUT+): Connect to the positive terminal of the PLC/DCS signal input;
- Terminal 10 (24V+): Connect to the positive terminal of the 24V DC power supply;
- Terminal 11: Unused pin; do not connect; seal with an insulating cap;
- Terminal 12 (24V-): Connect to the negative terminal of the 24V DC power supply;
- Shielding wire handling: Connect the shielding layer of the input/output shielded twisted-pair cable to the ground terminal on the control cabinet side; leave it floating on the field side to avoid grounding at both ends.

2. Custom Model-Specific Wiring Specifications

- 1-Input, 2-Output Model (1 input channel, 2 4-20mA output channels):
  - Input Terminals (1-2): Wiring method is the same as the standard model; connect to on-site AC/DC voltage signals;
  - Output Terminals (7-9, new terminal group): The two output groups are wired independently. The first group (OUT+ [Terminal 9] and OUT- [Terminal 7]) connects to the first downstream device, while the second group (OUT+ and OUT-) connects to the second downstream device. Both output signals are synchronized to accommodate different device requirements;
  - Power Terminals (10-12): Wiring is the same as the standard model; powered by 24 V DC, supplying power to both output groups simultaneously.
- AC 85–265V Wide-Voltage Power Supply Version:
  - Power Terminals (10–12): Terminal 10 connects to the AC 220V live wire (L), terminal 12 connects to the AC 220V neutral wire (N), and terminal 11 is left open; no grounding is required (but the housing must still be grounded);
  - Input and Output Terminals: The wiring method is the same as the standard model. Note that when using AC power, maintain sufficient spacing between the power terminals and the input/output terminals to prevent short circuits.
- Explosion-Proof Custom Model (Intrinsically Safe):
  - A safety barrier (Zener-type or isolation-type) must be installed first. Connect the safety barrier's input to the high-voltage signal from the field, and its output to the transmitter's input terminals (1-2) to prevent the high-voltage signal from being connected directly to the transmitter;
  - Connect the transmitter's output terminals (7-9) to the safety barrier's input terminals, and connect the safety barrier's output terminals to the downstream PLC/DCS to form an explosion-proof isolation circuit;
  - Connect the power terminals (10-12) to a 24 V DC power supply isolated by the safety barrier to ensure power supply safety. Additionally, both the enclosure and the safety barrier must be connected to the explosion-proof grounding network.





6.4. Power-On Commissioning Procedure (Step-by-Step Verification to Ensure Proper Equipment Operation)

After completing the wiring, perform step-by-step commissioning in the following order: "No-Load Test → Signal Verification → Indicator Light Check → Accuracy Calibration." Proceed to the next step only after confirming that the previous step is correct, to ensure accurate data acquisition and stable output. Strictly adhere to safety regulations during commissioning to prevent errors during live-wire operations.

6.4.1. No-Load Test (Pre-Power-On Inspection to Prevent Power-On Failures)

Before powering on, double-check the wiring. Once confirmed, perform a no-load test, focusing on the power supply and the device's basic status:

1. Double-check the wiring: Refer to the wiring diagram and terminal definitions in the images to confirm that the power supply, input, and output connections are not reversed, loose, or short-circuited; that the shielding wire is properly grounded; and that unused terminals are sealed;
2. Connect Power Supply: Connect the DC 24V power supply (standard model) and confirm that the supply voltage is within the 18V–30V range. For the AC wide-voltage model, confirm that the supply voltage meets the AC 85–265V requirement;
3. No-load Check: After powering on the device, observe the PWR power indicator light on the blue housing; it should immediately remain steady (see image annotation), with no flashing or turning off. The device should produce no abnormal noises and should not overheat (a slight rise in temperature is normal);
4. Output Signal Check: Use a multimeter to measure the output terminals (OUT+, OUT-). Under no-load conditions, the 4–20 mA output should be 4 mA (error ≤ ±0.3% FS), and the 0–5 V/0–10 V output should be 0 V. If the signal is abnormal, immediately disconnect the power and check the wiring.

6.4.2. Signal Calibration (Verifying Acquisition and Output Accuracy)

After confirming normal operation during no-load testing, connect the actual on-site voltage signal to perform signal calibration. This ensures acquisition accuracy and output signal linearity, meeting the requirements of downstream equipment:

1. Connect the input signal: Connect the on-site AC/DC voltage signal to the input terminals (IN+, IN-). Verify that the signal range matches the device's range (e.g., on-site AC 220V, device range AC 0–1000V);
2. Signal Acquisition Verification: Use a multimeter to measure the actual voltage at the input terminals and record the values; simultaneously measure the output signal at the output terminals (4–20 mA/0–10 V) to confirm that the output signal is linearly proportional to the input voltage (e.g., input AC 0 V → output 4 mA, input AC 1000 V → output 20 mA);
3. Multi-point Calibration: Select three different input voltage points (no-load, mid-range, full-scale), measure the output signal at each point, and ensure the error is ≤±0.3% FS (as indicated on the product label). If the error exceeds the limit, perform accuracy calibration;
4. Back-end Adaptation Verification: Connect the output signal to a PLC/DCS system. Observe the voltage values displayed by the system and compare them with the actual voltage measured by a multimeter to ensure consistency, with no fluctuations or distortion. If the system display is abnormal, check the output wiring and load matching.

6.4.3. Accuracy Calibration Method (On-site procedure; ensure accurate data acquisition)

The device has undergone factory accuracy calibration. If the error exceeds the tolerance during on-site commissioning, on-site calibration may be performed. Calibration requires a signal generator and a standard multimeter (accuracy ≥ Class 0.1). The steps are as follows (refer to the commissioning port locations indicated in the figure):

1. Calibration Preparation: Disconnect the on-site input signal and connect the signal generator; connect the signal generator to the transmitter's input terminals (IN+, IN-); connect the standard multimeter to the transmitter's output terminals (OUT+, OUT-), and set the corresponding measurement

mode (current range/voltage range);
2. Zero Point Calibration: Set the signal generator output to 0V (no load). Observe the output signal displayed on the standard multimeter. If it is not 4mA (current output) or 0V (voltage output), use a small screwdriver to rotate the "ZERO" calibration potentiometer on the device. Turning clockwise increases the zero point, while turning counterclockwise decreases it, until the output signal reaches the standard value (error ≤ ±0.1% FS);
3. Full-Scale Calibration: Set the signal generator output to the device's full scale (e.g., AC 1000V). Observe the output signal displayed on the standard multimeter. If it is not 20mA (current output) or 10V (voltage output), use a small screwdriver to rotate the "CAL" full-scale calibration potentiometer on the device. Turning clockwise decreases the full-scale value, while turning counterclockwise increases it, until the output signal reaches the standard value;
4. Repeat Calibration: Repeat the zero and full-scale calibrations 2–3 times. Select an intermediate value (e.g., 500 V AC) for verification to ensure the output signal error is ≤±0.3% FS. After calibration is complete, tighten the protective cap on the calibration potentiometer to prevent accidental contact;
5. Calibration Record: Record the calibration date, the person performing the calibration, and the calibration data for future maintenance and traceability. If the error remains outside the tolerance limits after calibration, contact the manufacturer to inspect the internal circuitry of the device.

6.5 Installation Prohibitions (Strictly Avoid to Reduce the Risk of Malfunctions)
Based on the product characteristics of the Qidian QD-21U and common installation issues encountered in the field, the following installation prohibitions are clearly defined. Strict adherence to these guidelines is required to prevent equipment damage, safety incidents, or data collection anomalies, and to ensure the long-term stable operation of the equipment:
1. Overvoltage power supply is strictly prohibited (Core Prohibition)
The standard QD-21U model operates on a DC voltage of 18V–30V (standard DC 24V), while the AC wide-voltage model operates on 85–265V AC. Connecting voltages outside the rated range is strictly prohibited. Specific prohibitions are as follows:
- Never connect a 220V AC power source directly to the power terminals of the standard DC 24V model, as this will immediately burn out the internal circuitry and render the device inoperable;
- Never use the device directly in environments where the supply voltage fluctuates by more than ±10%. A voltage regulator must be installed to prevent the device from failing to start or experiencing performance degradation due to excessively high or low voltage;
- Never reverse the positive and negative terminals of the power supply. Even though the device has built-in reverse connection protection, prolonged reverse connection will still damage the power module and affect the device's service life.
2. Avoid High-Voltage Interference (Ensure Signal Stability)
High-voltage interference can cause signal fluctuations, increased errors, and even equipment failure. The following practices must be strictly avoided:
- Never install the transmitter near sources of strong electromagnetic interference, such as transformers, high-power motors, or variable frequency drives (maintain a distance of at least 50 cm). If such proximity cannot be avoided, use a metal shielding enclosure and ensure the shielding wire is properly grounded;
- Never route input/output signal cables in the same conduit or bundle them parallel to power cables (e.g., AC 380V, AC 220V cables). Maintain a minimum distance of 15 cm between them to prevent high-voltage interference from being conducted to the signal lines;
- It is strictly prohibited to ground both ends of the shielded cable, as this creates a ground loop that introduces interference. The shielded cable must be grounded at one end (on the control cabinet side) and left floating on the field side;
- It is strictly prohibited to store strongly magnetic materials near the equipment, as this may affect the internal isolation circuits and signal acquisition accuracy.
3. Protective Measures for Humid Environments (To prevent moisture damage to the equipment)
Humid environments can cause short circuits in internal circuits and degrade insulation performance, leading to equipment failure. The following protective measures must be taken to strictly mitigate the effects of humidity:
- Never install standard models in areas with standing water or condensation (e.g., outdoors without a protective shelter, or flooded areas in underground electrical rooms). In such scenarios, select the custom potted moisture-proof model (IP65 protection rating);
- When installing in humid environments, mount the transmitter at a high position inside the control cabinet, away from the floor and areas with standing water. The control cabinet must be properly sealed and equipped with moisture-proof and dehumidification devices;
- During wiring, ensure the cable entry points face downward and are fitted with waterproof bends to prevent rainwater and moisture from seeping into the equipment through the cables. Apply insulating sealant to the terminal blocks to enhance moisture resistance;
- In humid environments, regularly check the equipment's insulation resistance (at least once a month) to ensure it is ≥100 MΩ. If insulation resistance drops, immediately disconnect power and dry the equipment to prevent short-circuit failures.
4. Other Installation Precautions
- Never connect, disconnect, calibrate, or disassemble the equipment while it is energized to avoid electric shock and equipment damage;
- Do not arbitrarily adjust the internal calibration potentiometers. After factory calibration, non-professionals must not make unauthorized adjustments to prevent loss of accuracy;
- Do not use the transmitter housing to support weight, as this may cause deformation of the housing and loosening of internal components, affecting equipment performance;
- Do not use non-explosion-proof models in explosion-hazardous environments. Do not connect high-voltage signals without a safety barrier, as this violates explosion-proof regulations.
Additional Notes: After installation and commissioning are complete, maintain detailed installation records, including the installation location, wiring configuration, and calibration data, to facilitate future maintenance and troubleshooting. During the initial operation period, it is recommended to check the indicator light status and output signal daily to ensure stable operation.

7: Recommendations for Daily Use & Maintenance
7.1 Key Points for Daily Inspections (Daily/Weekly Checks, Quick Troubleshooting)
Based on the structural features of the Qidian QD-21U (PWR indicator light, terminal connections, and environmental adaptation design), three core inspection steps have been established. These can be completed without specialized tools and allow for a quick assessment of the device's operational status.
1. Observe Indicator Light Status (Daily Inspection, Takes 1 Minute)
PWR Power Light (Standard) Steady On,
Normal Status: Even brightness with no flickering
Abnormal condition: Off / Flashing / Brightness fluctuating
Quick troubleshooting steps: ① Check if the DC24V supply voltage is within the 18–30V range; ② Check if the power terminal connections are loose or faulty; ③ Confirm if there is a short circuit in the power circuit or if the overload protection has been triggered.
2. Signal Stability Monitoring (Weekly Inspection, Compatible with PLC/DCS Systems)
System Data Verification: Review the voltage data collected by the PLC/DCS system to observe for anomalies such as sudden jumps, irregular fluctuations, or stagnant values. Normal data should linearly correspond to the actual on-site voltage, with an error of ≤±0.3% FS.
Load Status Check: Measure the current/voltage signals in the output circuit to confirm that the output load is within the equipment's rated range (current-type ≤ 500 Ω, voltage-type ≥ 2 kΩ) to prevent signal distortion caused by load mismatch.
Interference Troubleshooting: If data fluctuates, check whether signal cables are routed in the same conduit as power cables and whether the shielding is properly grounded (single-ended grounding), and adjust the cabling method promptly.
3. Temperature, Humidity, & Environmental Monitoring (Weekly inspections to prevent environmental failures)
Temperature Monitoring: Use an infrared thermometer to measure the equipment enclosure temperature. The normal operating temperature should be within the range of -20°C to +60°C. If the enclosure temperature exceeds 70°C, investigate the following: ① Whether the power supply is overloaded; ② Whether the installation location is

near a heat source (such as an inverter or heating equipment); ③ Whether the control cabinet has poor heat dissipation.
Humidity Monitoring: Check the installation location for condensation or water accumulation. Humidity must be maintained between 10% and 90% RH (non-condensing). In humid environments, verify whether the equipment is a potted moisture-proof model; if it is a standard model, promptly install moisture-proof measures.
Surrounding Environment Inspection: Ensure there is no conductive dust, corrosive gases, or strongly magnetic materials around the equipment. Keep it away from sources of strong electromagnetic interference, such as high-power motors and transformers (minimum distance ≥ 50 cm).

7.2. Regular Maintenance Schedule (Monthly / Quarterly / Annual, Standardized Maintenance Procedures)
1. Cleaning and Maintenance (Performed monthly to maintain equipment heat dissipation and insulation performance)
Cleaning Frequency: Once every 3 months in standard industrial environments; once a month in dusty, humid, or corrosive environments.
Cleaning Steps:
Power-Off Procedure: Disconnect the transmitter's power supply and input signal power source, and post a "Do Not Operate" sign.
Housing Cleaning: Gently brush away dust from the blue housing surface and heat dissipation vents using a dry, soft-bristled brush. Never rinse directly with water to prevent moisture from penetrating the internal circuitry.
Terminal Cleaning: Wipe the terminal blocks with anhydrous alcohol to remove oxidation and grease. Ensure the contact surfaces are clean and free of contaminants to improve electrical conductivity.
Drying and Ventilation: After cleaning, keep the equipment in a well-ventilated, dry area. Do not power on until the terminals are completely dry to prevent short circuits.
2. Wiring Tightness Inspection (Performed quarterly to prevent signal abnormalities caused by loose connections)
Inspection Frequency: Once per quarter for all industrial environments; once per month for environments with vibration or strong impact.
Inspection Items:
Terminal Tightening: Use a torque wrench to retighten the screws on power, input, and output terminals to the standard torque (0.8–1.2 N·m) to prevent loosening and loose connections caused by vibration.
Cable Inspection: Inspect power and signal cables for damaged or aged outer sheaths, broken shielding wires, and loose ground terminals. Replace damaged cables promptly and re-crimp terminals.
Grounding Inspection: Verify that the equipment housing and shielding wires are securely grounded, with ground resistance ≤4 Ω, to prevent interference caused by poor grounding.
3. Accuracy Retesting and Calibration (Performed annually to ensure measurement accuracy meets standards)
Retesting Frequency: Once per year for general industrial applications; once every 6 months for high-precision control/metering applications.
Retesting and Calibration Procedure:
Prepare Tools: Standard multimeter (accuracy ≥ Class 0.1), signal generator, insulation tester.
Insulation Test: Use an insulation tester (500 V DC) to measure the insulation resistance between device terminals, ensuring it is ≥100 MΩ. If insulation resistance has decreased, investigate potential issues such as moisture ingress or aging.
Accuracy Retest: Connect a signal generator and select three points—zero, mid-range, and full scale—to measure output signal error. Normal error should be ≤±0.3% FS.
Calibration Adjustment: If the error exceeds the tolerance, adjust the "ZERO" zero-point potentiometer and the "CAL" full-scale potentiometer according to the equipment calibration procedure. Record the results after calibration for future traceability.
Calibration Record: Complete the calibration record form, noting the calibration date, the person performing the calibration, and any data deviations, and maintain an equipment maintenance file.

7.3 Long-Term Maintenance Tips (Full-Cycle Protection to Extend Equipment Lifespan)
1. Dust and Moisture Protection (Prevent Environmental Degradation and Reduce Failure Rates)
Dust Prevention Measures:
Control Cabinet Installation: Install the equipment inside a sealed control cabinet to avoid direct exposure to dusty environments. Fit the control cabinet with dust filters and clean the filters regularly to remove dust.
Terminal Protection: Seal unused terminals with insulating caps to prevent dust from entering and causing poor contact.
Protection for Special Environments: In highly dusty environments such as metallurgy and cement plants, custom-made potted moisture-proof equipment can be used to enhance the IP protection rating and reduce dust ingress.
Moisture Protection Measures:
Condensation Protection: In humid environments, install moisture-proof and dehumidifying devices (such as desiccants or dehumidifiers) inside the control cabinet to prevent condensation on the equipment surface.
Cable Waterproofing: Cable entry points should face downward and be fitted with waterproof bends to prevent rainwater and moisture from seeping into the equipment along the cables. Apply insulating sealant to terminal blocks to enhance moisture resistance.
Outdoor Environment Protection: For outdoor photovoltaic and energy storage applications, install equipment inside waterproof enclosures to prevent direct exposure to rain. Select custom models with UV-resistant housings to prevent aging and cracking of the casing.
2. Interference Mitigation Optimization (Improving Signal Stability, Reducing Data Fluctuations)
Cabling Optimization:
Signal cables and power cables must be laid separately, with a minimum spacing of 15 cm between them. It is strictly prohibited to route them in the same cable tray or bundle them in parallel to prevent the conduction of high-voltage interference.
Input/output signal cables must use shielded twisted-pair cables, with the shield grounded at one end (on the control cabinet side) and left floating on the field side to prevent ground loops.
Grounding Optimization:
Equipment enclosures and system grounding must be connected to a single grounding grid with a grounding resistance ≤4Ω. Mixing with the neutral (N) line is strictly prohibited.
In high-interference environments, install signal isolators and power filters to further suppress electromagnetic interference and improve signal stability.
Installation Optimization:
Install the equipment away from strong electromagnetic interference sources such as transformers, variable frequency drives, and high-power motors, maintaining a distance of ≥50 cm. If separation is not possible, install a metal shielding enclosure for protection.
3. Extreme Environment Protection (Adapted for non-standard operating conditions to ensure long-term operation)
Protection in High and Low Temperature Environments:
Low-temperature environments (below -20°C): Select custom wide-temperature range equipment (-40°C to +85°C) and install heating devices inside the control cabinet to prevent component performance degradation caused by low temperatures.
High-temperature environments (above +60°C): Select wide-temperature range equipment and install cooling fans and heat sinks in the control cabinet to prevent accelerated aging caused by prolonged exposure to high temperatures.
Protection in Highly Corrosive Environments:
In corrosive environments such as chemical processing and wastewater treatment, select equipment with custom corrosion-resistant enclosures. Apply anti-corrosion coatings to the enclosures and install corrosion-resistant components inside the control cabinets to prevent damage from corrosive gases.
Protection Against High-Vibration Environments:
In high-vibration environments such as metallurgy and mining, select ruggedized equipment. Use anti-loosening screws for terminals and mount the equipment on rails equipped with vibration-damping pads to prevent component loosening or damage caused by vibration.

Supplement: Emergency Troubleshooting for Equipment Failures
Power Indicator Light Off: Immediately disconnect power, check supply voltage and power connections, troubleshoot for short circuits or overloads, and restore power only after the fault has been resolved.
No Signal Output: Disconnect power and check the output circuit wiring for open circuits or short circuits; verify load compatibility; troubleshoot for internal circuit faults.
Severe Data Fluctuations: Check shielding wire grounding and cabling methods; keep equipment away from interference sources; verify if the equipment is damp or has degraded insulation.

VIII: Troubleshooting & Emergency Response Manual

8.1 List of Common Faults (Quick Reference for Frequent Issues)

No Output: Output signal is 0 mA/0 V; PLC/DCS does not collect data System cannot monitor voltage status; automated processes are interrupted

Signal Drift / Large Error: Output signal continuously drifts; data deviates from actual voltage by more than ±0.3% FS Control logic misjudgment, leading to abnormal equipment operation and product quality fluctuations

Abnormal Indicator Lights: PWR light off / flashing; ALM light flashing irregularly Equipment status cannot be determined; potential power supply or fault issues exist

Alarm Triggered (Custom Models): ALM light continuously flashing / constantly lit System triggers interlock protection; equipment shuts down

Interference, Distortion, or Data Jitter Output signal fluctuates irregularly; severe data jitter Acquired data is unreliable; system control fails

8.2 In-Depth Analysis of Failure Causes (Root Cause Identification)

1. No Output Failure

Power Supply Abnormalities: 24 VDC power supply failure; voltage outside the 18–30 V range; reversed, loose, or shorted power supply terminals

Wiring Errors: Reversed polarity at output terminals; open circuit or short circuit in the output circuit; load exceeding the device's rated range

Internal Equipment Damage: Power module burnout, output circuit damage (e.g., caused by prolonged overvoltage or overcurrent)

Abnormal Input Signal: Input voltage is 0V and the transmitter has no zero-point output, input terminals are open

2. Signal Drift / High Error Faults

Accuracy Not Calibrated: Factory calibration has expired, or changes in the on-site environment have caused zero-point or full-scale offset

Load mismatch: Current-loop output load > 500Ω, voltage-loop output load < 2kΩ, resulting in signal attenuation

Signal overload: Input voltage exceeds the transmitter's rated range, causing nonlinear distortion in internal circuits

Device aging: Component performance degradation and reduced linearity due to prolonged exposure to high temperatures or humid environments

3. Indicator Light Malfunctions

PWR light off: Power interruption, reversed polarity, burned-out power module, or internal short circuit

PWR light flashing: Excessive power supply voltage fluctuations, poor power circuit contact, or internal circuit abnormality

ALM light false alarm: Input signal fluctuations, abnormal output load, or incorrect alarm threshold settings

4. Alarm Triggering (Custom Models) Faults

Input Out-of-Range: Field voltage exceeds the transmitter's rated range, triggering an out-of-range alarm

Output Circuit Fault: Open circuit or short circuit in the output signal, causing output module malfunction and triggering an alarm

Internal Equipment Fault: Damaged isolation circuit, operational amplifier failure, triggering a fault alarm

Environmental Abnormalities: Equipment is in a high-temperature or humid environment, triggering an internal circuit protection alarm

5. Interference Distortion / Data Jitter Faults

Wiring Interference: Signal lines are routed in the same conduit as power cables; unshielded twisted-pair cables are used; shielding is grounded at both ends

Poor Grounding: The device housing or shielding is not securely grounded; grounding resistance > 4Ω

Strong electromagnetic interference: Installation location is near strong interference sources such as transformers, variable frequency drives, or high-power motors

Ground loop interference: Multiple devices sharing a common ground creates a ground loop, introducing common-mode interference and causing data fluctuations

8.3 Step-by-Step Troubleshooting (Troubleshooting and Repair for Specific Faults)

1. Fault 1: No Output

Power Supply Check:

Use a multimeter to measure the voltage at the power supply terminals (24V+, 24V-) and confirm it is within the range of 18–30 V DC. If the voltage is 0 V, check whether the circuit breaker or fuse in the power supply circuit has tripped;

Check if the power terminal wiring is reversed; reconnect according to the standard wiring: "24V+ to power positive, 24V- to power negative";

If the power supply is normal but the PWR indicator remains off, the power module may be damaged; proceed to the contingency plan.

Output Circuit Check: After powering down, check whether the wiring at the output terminals (OUT+, OUT-) is reversed or loose. Use a multimeter to measure whether the output circuit is open or shorted; Measure the input impedance of the downstream equipment. Confirm that the current-type output load is ≤500Ω and the voltage-type output load is ≥2kΩ. If the load is mismatched, replace it with a compatible load or install a signal amplifier; After rewiring, power on the unit and use a multimeter to measure the output signal. The 4–20 mA output should be 4 mA under no-load conditions, and the 0–10 V output should be 0 V. If there is still no signal, proceed to the contingency plan.

Input Signal Check: Measure the actual voltage at the input terminals (IN+, IN-) to confirm that a signal is present and does not exceed the measurement range. If the input voltage is 0 V, troubleshoot for faults in the on-site signal circuit.

Emergency Workaround

If the control loop is non-critical, temporarily replace the unit with a spare QD-21U transmitter to quickly restore signal acquisition;

If no spare equipment is available, use a generic voltage transmitter of the same specifications as a temporary replacement, ensuring that the input/output signal types, range, and power supply method are fully compatible. Replace with the original equipment once repairs are complete.

2. Fault 2: Signal Drift / Large Error

Load Matching Check: Measure the load resistance of the output circuit. If it exceeds the rated range, adjust the input impedance of the downstream equipment or replace the output signal cable to ensure load matching;

Accuracy Retest and Calibration: Use a standard multimeter (accuracy ≥ Class 0.1) to measure the input voltage and output signal, and record the error values; If the error exceeds ±0.3% FS, adjust the "ZERO" zero-point potentiometer and "CAL" full-scale potentiometer according to the calibration procedure to complete three-point calibration (zero, mid-range, and full-scale); remeasure the error after calibration. If it still exceeds the limit, investigate equipment aging or internal circuit faults.

Range Compatibility Check: Verify that the input voltage does not exceed the transmitter's rated range. If the range is too narrow, replace the transmitter with one suitable for the range or order a custom-range upgrade model.

Emergency Workaround

Temporarily adjust the signal correction coefficient in the PLC/DCS system to compensate for the current error and ensure normal system control logic;

If the error continues to increase, replace the transmitter with a spare unit and resume use once the original device has been calibrated or repaired.

3. Fault 3: Abnormal Indicator Lights

PWR light off: Follow the power supply troubleshooting steps for the "No Output" fault. If the light remains off after confirming normal power supply, determine that the device's power module is damaged;

PWR light flashing: Check for fluctuations in the supply voltage and install a 24V DC voltage regulator. If the light continues to flash after the voltage stabilizes, investigate internal circuit faults;

ALM light false alarm: Check for momentary out-of-range input signals or fluctuations in the output circuit. If the signals are normal, the issue may be incorrect alarm threshold settings or an internal device fault; reset the thresholds or contact the manufacturer for repair.

Emergency Workaround

If the indicator light malfunctions but the device continues to collect signals normally, you may temporarily disregard the indicator light status. Determine the device's operating status based on data from the PLC/DCS system, while simultaneously recording the device's operating conditions.

Replace the indicator light or repair the device during a scheduled shutdown.

4. Fault 4: Alarm Triggered (Custom Model)

Input Over-Range Alarm: Measure the input voltage to confirm whether it exceeds the transmitter's rated range. If the over-range condition occurs under normal operating conditions, replace the transmitter with one rated for a higher range; if it is caused by momentary fluctuations, adjust the PLC system's filtering parameters to prevent false alarms;

Output Circuit Fault Alarm: After powering down, check whether the output terminal wiring is open or shorted. After repairing the wiring, power on and test; if the alarm persists, investigate whether the output module is damaged;

Environmental Abnormality Alarm: Measure the equipment housing temperature and installation environment humidity. If these exceed the equipment's rated range, install cooling or moisture-proof devices to improve environmental conditions.

Emergency Workaround

Temporarily disable the PLC system's alarm signals to ensure the equipment continues to operate, while assigning a dedicated person to monitor voltage data on-site; restore the alarm function once the fault is resolved; replace the transmitter with a spare unit to quickly clear the alarm status and restore normal system operation.

5. Fault 5: Interference Distortion / Data Fluctuations

Wiring and Grounding Optimization: Check whether signal cables are routed in the same conduit as power cables; reroute signal cables to a separate conduit, maintaining a distance of ≥15 cm from power cables; confirm that signal cables are shielded twisted-pair cables with the shield grounded at one end (control cabinet side) and left floating at the field side to avoid ground loops caused by grounding at both ends; Check whether the equipment enclosure and shielding wire grounding connections are secure; retighten the grounding terminals to ensure grounding resistance ≤ 4Ω;

Adjust the installation location: If the equipment is near a strong interference source, relocate it away from transformers and inverters (minimum distance ≥ 50 cm); if relocation is not possible, install a metal shielding enclosure;

Interference mitigation upgrade: Install a 24V DC power filter in the power supply circuit to suppress power-side interference; install a signal isolator in the output circuit to further filter out signal interference.

Emergency workaround

Temporarily adjust the signal filtering parameters of the PLC system, extend the signal sampling period, and reduce the impact of interference on system control;

If interference severely affects control logic, replace the transmitter with a spare unit and resume use of the original equipment once the wiring and grounding have been optimized.

8.4 After-Sales Repair Guidelines (Standardized Process, Rapid Response)

1. Failure Determination Criteria (If the following conditions are met, it is recommended to submit a service request)

If the fault cannot be located or repaired after the above step-by-step troubleshooting, such as:

Power supply is normal but the PWR indicator remains off, and the device has no output;

After repeated calibration, the signal error still exceeds ±0.3% FS, failing to meet data acquisition accuracy requirements;

Internal circuit damage (e.g., module burnout, component failure) requiring return to factory for repair;

The device has sustained irreversible damage, such as: cracked casing, burnt terminals, or short circuits caused by water ingress or moisture;

The device is within the warranty period and exhibits performance failures not caused by improper operation.

2. Repair Process (Four-Step Quick Repair)

2.1. Prepare Fault Information:

Product Model: Qidian QD-21U;

Device Serial Number / Batch Number (as indicated on the certificate of conformity or device label);

Fault Symptoms: Time of occurrence, on-site conditions (power supply, environment, load status), troubleshooting process and results;

Proof of Purchase: Order number, purchase date, procurement channel.

2.2. Contact After-Sales Channels:

Official After-Sales Hotline: 19715617532 (Weekdays 9:00 AM–6:00 PM);

Email Support: sales008@qd-zdk.com (24-hour response);

Dealer Service Request: Contact the dealer from whom the equipment was purchased; the dealer will assist in submitting the service request.

2.3. Submitting a Service Request:

Submit fault details via the hotline or email; an after-sales engineer will conduct an initial diagnosis of the cause and provide remote technical support;

If the issue cannot be resolved remotely, follow the after-sales guidelines to initiate the equipment return-to-factory repair process and complete the "Equipment Service Request Form."

2.4. Equipment Repair and Return:

Returned equipment will be inspected by the manufacturer's technical department, which will issue a repair report specifying the cause of the failure, the repair plan, and the repair timeline;

Upon completion of repairs, the equipment will undergo factory calibration and testing. Once passed, it will be shipped back to the customer's site, accompanied by a post-repair warranty commitment.

3. Warranty Scope

Warranty Period: 12 months from the date of manufacture. During this period, free repair or replacement services are provided for failures not caused by human error or force majeure;

Out-of-Warranty Services: For equipment beyond the warranty period, paid repair services are available, with charges for inspection, parts, and labor. A 3-month warranty is provided after repair;

Exclusions: The following situations are not covered by the free warranty:

Damage caused by improper operation (e.g., overvoltage supply, incorrect terminal connections, unauthorized disassembly of the equipment);

Damage caused by force majeure (e.g., lightning strikes, fire, earthquakes, floods, etc.);

Failures resulting from repairs or modifications performed by third parties not authorized by the manufacturer;

Equipment aging or damage caused by failure to install or maintain the equipment in accordance with specifications.

Supplement: Emergency Response Tips

It is recommended to have 1–2 spare QD-21U transmitters from Qidian on hand for critical control loops to enable quick replacement in the event of a failure, thereby minimizing downtime;

A field equipment operation and maintenance log should be established to record the installation date, calibration history, and repair history of each transmitter, facilitating future traceability and maintenance;

Non-professionals are strictly prohibited from disassembling the equipment or adjusting internal circuits without authorization. Failure to comply will void the warranty and may result in equipment damage or safety incidents.